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Methods & Assumptions Meeting Documentation

1. Methods and Assumptions Cover Page

I-90 Exit 59 (La Crosse Street) Interchange Options Study – Amendment 1

To:	Study Advisory Team (SDDOT, FHWA, City of Rapids City)		
From:	Jody Paige, HDR Brian Ray, HDR Mike Forsberg, HDR	Project:	I-90/La Crosse Street Interchange Study Project PL 0100(89) 3616 P, PCN 03KM
CC:	File		
Date:	June 19th, 2013	Job No:	183454

Methods and Assumptions Document

This Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on June 26th, 2012 with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Rapid City, and HDR. Amendment 1 includes changes to accommodate analysis of a Diverging Diamond Interchange (DDI) and addresses the level of detail that will be addressed in each of the eight (8) policy points that will be conducted to perform an Interchange Modification Justification Report. This document is intended to serve as a historical record of the process, dates, and decisions made by the study team representatives for the ***I-90 Exit 59 (La Crosse Street) Interchange Options Study***.

2. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the ***I-90 Exit 59 (La Crosse Street) Interchange Options Study*** as presented in this document.

SDDOT:

Signature

Data Analysis Engineer

Title

9-4-2012

Date

FHWA:

Signature

Quality / Operations Engineer

Title

9/7/2012

Date

The undersigned parties concur with Amendment 1 to this document.

SDDOT:

Signature

Data Analysis Engineer

Title

6-24-2013

Date

FHWA:

Signature

Planning/Civil Rights Spec.

Title

6/24/13

Date

Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-90 Exit 59 (La Crosse Street) Interchange Options Study*** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

3. Introduction and Project Description

Project Background and Understanding

The I-90/La Crosse Street interchange ranks 5th out of the 126 interchanges in South Dakota that were evaluated based on weighted crash rates (*South Dakota Decennial Interstate Corridor Study, 2010*). The purpose of this study is to address the congestion and safety concerns at the I-90/La Crosse Street interchange which serves the growing northeast edge of Rapid City. This interchange options study will develop conceptual designs and perform traffic analysis for various interchange options.

Location

The study area is located in Northeastern Rapid City immediately east of the I-190 spur. Three interchanges are located on I-90 within the study area, Haines Avenue, La Crosse Street and North Street.

Need for Study

The study team has determined the following needs for this specific study:

- Congestion at the La Crosse Street interchange.
- Safety concerns at the La Crosse Street interchange.

Study Schedule

Date	Task/Event
2012 May – June	Notice to Proceed; Data collection
July	Methods & Assumptions Documentation
August – September	Existing conditions analysis
October	Business/Landowner Group Meetings; Public Meeting #1
November – January **(2013)**	Develop, document and analyze interchange and roadway options
February	Business/Landowner Group Meetings; Public Meeting #2
March	Refine options
April – June	Prepare draft Interchange Modification Justification Report (IMJR); Identify recommended option(s)
July	Present recommended option(s) to Metropolitan Planning Organization (MPO); Public Meeting #3
August – October	Select recommended option(s); Revise draft IMJR
November	Submit Final IMJR; Present Final Report to MPO

Facilities Affected by the Study

Modifications to the I-90 Exit 59 (La Crosse Street) interchange would have the potential to affect the intersections on La Crosse Street adjacent to the interstate ramp terminal intersections (La Crosse Street/Disk Drive and La Crosse Street/Eglin Street). Modifications at Exit 59 would also have the potential to affect the adjacent interchanges on I-90 at Haines Avenue and North Street.

Previous Studies

The following previous studies will be reviewed during the course of this study:

- 2010 Decennial Interstate Corridor Study Phases 1, 2, & 3
  - http://www.sddot.com/transportation/highways/planning/specialstudies/Default.aspx
- 2003 Eglin Street Study
  - http://www.rcgov.org/Transportation-Planning/special-planning-studies.html
- RapidTRIP 2035 Metropolitan Planning Organization (MPO) Long-Range Transportation Plan (LRTP)
  - http://www.rcgov.org/Transportation-Planning/special-planning-studies.html
- 2011 Rapid City Area Bicycle and Pedestrian Master Plan
  - http://www.rcgov.org/Transportation-Planning/special-planning-studies.html

- Rapid City Arterial Street Safety Study
  - http://www.rcgov.org/Transportation-Planning/special-planning-studies.html
- Rapid City Major Street Plan
  - http://www.rcgov.org/Transportation-Planning/major-street-plan.html
- Anamosa Street Extension Study

Study Advisory Team Members

A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, FHWA and City of Rapid City. Members of the Study Advisory Team are:

Stacy Bartlett	SDDOT – Road Design (Traffic)	Steve Johnson	SDDOT – Bridge Design
Jeff Brosz	SDDOT – Trans. Inv. Management	John Mattheson	SDDOT – Region Traffic Engineer
Steve Gramm	SDDOT – Project Development	Karen Olson	SDDOT – Road Design
Kip Harrington	Rapid City – Community Planning	Brad Remmich	SDDOT – Project Development
Marc Hoelscher	FHWA	Todd Seaman	SDDOT – Rapid City Region
Patsy Horton	Rapid City – Community Planning	Dale Tech	Rapid City – Public Works

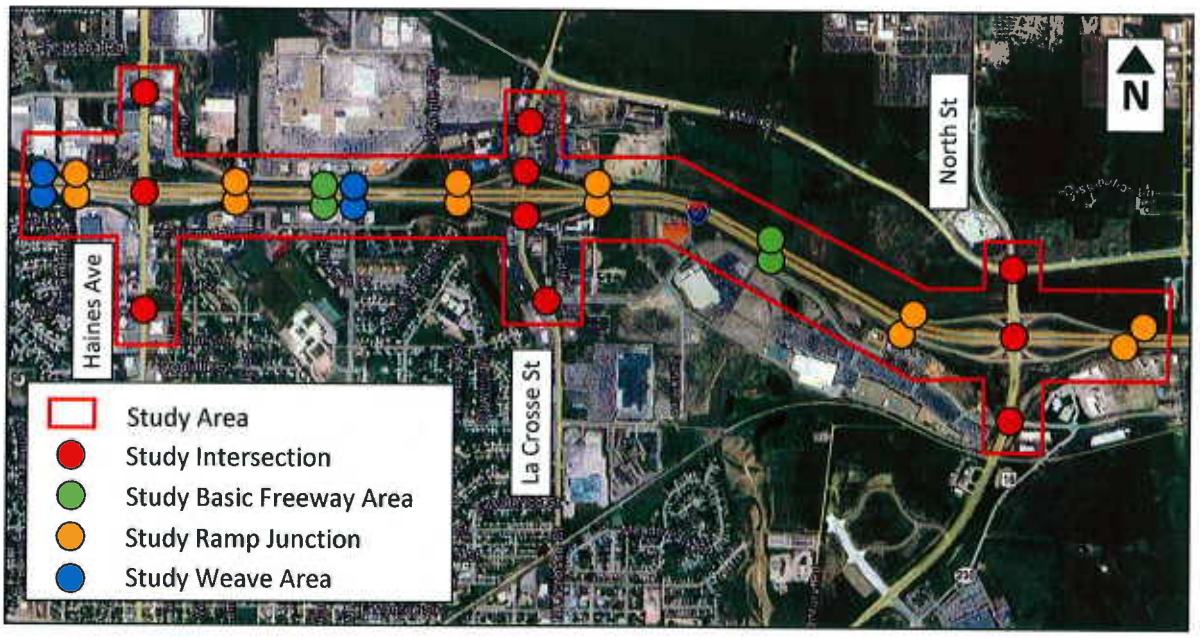
Additional team members may be added as the study progresses.

Study Complexity

This study will evaluate a variety of options for a new interchange configuration at Exit 59 (La Crosse Street). Access points on La Crosse Street that are close in proximity to the I-90 ramp terminal intersections present the complex issue of maintaining access with the interchange options being considered. Another complex issue is the desire to maintain the existing La Crosse Street bridge structure over I-90.

4. Study Area

The study area was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains the I-90 interchanges in northeast Rapid City at La Crosse Street, Haines Avenue and North Street. The following graphic shows the study intersections with red dots, ramp junction analysis locations with orange dots and weave areas with blue dots. The study area is bounded by a red box on the graphic. A list of study intersections and ramp junctions are also provided.



Study Intersections:

- La Crosse Street Study Intersections
  - La Crosse Street/Disk Drive
  - La Crosse Street/I-90 Westbound Ramp Terminal
  - La Crosse Street/I-90 Eastbound Ramp Terminal
  - La Crosse Street/Eglin Street
- Haines Avenue Study Intersections
  - Haines Avenue/Disk Drive
  - Haines Avenue/I-90 Single Point Ramp Terminal
  - Haines Avenue/Lindbergh Street
- North Street Study Intersections
  - North Street/Mall Drive
  - North Street/I-90 Single Point Ramp Terminal
  - North Street/Eglin Street

Study Basic Freeway Areas (*See also Note 1 below*):

- I-90 Eastbound
  - Segment between Haines Avenue and La Crosse Street
  - Segment between La Crosse Street and North Street
- I-90 Westbound
  - Segment between North Street and La Crosse Street
  - Segment between La Crosse Street and Haines Avenue

Study Ramp Junctions (*See also Notes 1 and 2 below*):

- I-90 Eastbound
  - Diverge to Haines Avenue
  - Merge from Haines Avenue
  - Diverge to La Crosse Street
  - Merge from La Crosse Street
  - Diverge to North Street
  - Merge from North Street
- I-90 Westbound
  - Diverge to North Street
  - Merge from North Street
  - Diverge to La Crosse Street
  - Merge from La Crosse Street
  - Diverge to Haines Avenue
  - Merge from Haines Avenue

Notes:

(1) The ramp junctions and basic freeway segments between Haines Avenue and La Crosse Street will also be evaluated as weaving areas to evaluate the possible addition of an auxiliary lane between the two interchanges.

(2) Ramp junctions on the west side of the Haines Avenue interchange are part of weave areas with the ramps to/from I-190. These locations will be analyzed as weaves with data obtained for the I-190 ramps.

5. Analysis Years/Periods

This study will evaluate traffic during and for the following time periods:

Existing Conditions – Existing conditions analyses will be conducted for year 2011/2012 volume conditions. Counts from November/December year 2011 will be compared to counts conducted during the summer (peak season) of year 2012 and the higher volume set will be used to analyze existing conditions. During the summer months traffic volumes are generally higher than other months in Rapid City as a result of tourism in the area. For existing conditions the following time periods will be evaluated:

- Existing Conditions (Year 2012) – AM Peak Hour
- Existing Conditions (Year 2012) – PM Peak Hour

Design Conditions – Design conditions analyses will be conducted for year 2035 peak season conditions. The projected traffic volumes from the Rapid City MPO Travel Demand Model will be utilized to determine year 2035 volumes. The Travel Demand Model was calibrated and updated in year 2008 to a planning horizon of year 2035. For the design conditions the following time periods will be evaluated:

- Design Conditions (Year 2035) – AM Peak Hour
- Design Conditions (Year 2035) – PM Peak Hour

Interim Conditions – No interim conditions will be evaluated as part of this study.

6. Data Collection

Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Data

SDDOT provided turning movement counts collected at the study intersections. These turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts provided were conducted in November/December of year 2011. Seven of the 10 intersection counts from year 2011 included 12 hours of data (6 AM to 6 PM) in 15-minute intervals. The other intersection counts from year 2011 also included data over the 12-hour period between 6 AM and 6 PM in 15-minute intervals but were missing data for portions of the 12-hour period (including portions of the AM/PM peak period).

Existing Freeway Data

No existing freeway data was provided. Study intersection turning movement counts will be used to determine existing AM and PM peak hour ramp volumes at the three I-90 interchanges within the study area.

Additional Data Collection Needed

Additional data collection is needed to complete project tasks. Additional data needs include intersection turning movement counts, freeway counts, arterial spot speed study, Travel Demand Model volumes and existing signal timings.

Turning movement counts will be collected by HDR at the study intersections on La Crosse Street during the summer of year 2012 on a Tuesday, Wednesday or Thursday to capture peak season traffic volumes on a typical weekday. These turning movement counts will be collected during the AM and PM peak periods in 15-minute intervals. Additionally, these turning movement counts will also include truck counts at the intersections to determine arterial truck percentages. Turning movement counts (including truck counts) will also be conducted by HDR at the Haines Avenue/I-90 single point ramp terminal, Haines Avenue/Lindbergh Street and North Street/Mall Drive intersections during the AM and PM peak periods to replace counts with missing data. A separate turning movement count at the La Crosse/I-90 Eastbound Ramp Terminal study intersection will be conducted by HDR on a Saturday during the summer of year 2012 to determine variations in traffic volumes between a typical weekday and Saturday during the peak season. Additional counts may be conducted on a Saturday depending on the variations between weekday and Saturday traffic volumes.

Freeway counts will be collected by HDR at one location on I-90 within the study area during the summer of year 2012. The freeway counts will be collected for each direction of travel on I-90 during the AM and PM peak periods in 15-minute intervals and will include classification to determine truck percentages along I-90. These freeway counts will be used in combination with interchange ramp traffic volumes from intersection turning movement counts at each study interchange to determine freeway volumes at all freeway locations within the study area.

HDR will also conduct origin-destination studies for the freeway locations between the I-90 interchanges at I-190 and Haines Avenue and between the I-90 interchanges at Haines Avenue and La Crosse Street. As part of these studies freeway counts for the I-190 northbound to I-90 eastbound ramp and the I-90 westbound to I-190 southbound ramp during the AM and PM peak periods in the summer of year 2012 will be conducted. This data will be used when analyzing weaving segments between the I-190 and Haines Avenue interchanges on I-90 and the potential weaving segment between Haines Avenue and La Crosse Street interchanges on I-90 with the addition of an auxiliary lane between Haines Avenue and La Crosse Street.

HDR will conduct a spot speed study along La Crosse Street during off-peak times of a typical weekday to determine the free-flow speed of traffic on La Crosse Street to be used in the analysis. Data collected at the location on La Crosse Street will be used for the free-flow speed of all arterials in the study area (the posted speed on the three arterials in the study area is 35 mph).

The City of Rapid City will provide shapefiles from the Travel Demand Model of roadways in Rapid City, including roadways within the study area, that include year 2008 annual daily traffic (ADT) volumes (non-peak season) and year 2035 post-processed ADTs (non-peak season). These ADTs will be used in combination with the existing intersection turning movement counts and freeway counts to determine year 2035 AM and PM peak hour volumes.

Signal timings will be provided by the City of Rapid City.

The inclusion of simulation on this project is still being determined. If it is determined to include VISSIM simulation, travel time runs along La Crosse Street and saturation flow rates at La Crosse Street signalized intersection approaches will need to be conducted for use in calibrating the simulation models.

Data Collection Techniques

All data was collected and will be collected using standard field practices which consist of using cameras, digital count boards or tube counters.

7. Traffic Operations Analysis

Traffic Operations Analysis

1. Software
    a. Signalized Intersections
        i. Highway Capacity Software (HCS) Release 6.5 (currently in beta) (2010 HCM Methodology) Streets Module
            1. La Crosse Street within the study area
                a. The I-90 ramp terminal intersections at La Crosse Street will be analyzed as part of the La Crosse Street analysis with the HCS Streets Module
                b. Analysis of a Diverging Diamond Interchange will be completed using HCS Release 6.5 (currently in beta) (2010 HCM Methodology). The methodology of analyzing this geometric configuration will follow the methodology outlined

in the 'Analysis Procedures for Diverging Diamond Interchange (DDI)' memorandum, found in the Appendix.

b. Basic Freeway, Ramp Junctions and Weave Areas
    i. HCS Release 6.5 (currently in beta) (2010 HCM Methodology)

2. Operational Analysis Assumptions
    a. Level of Service (LOS)
        i. Signalized Ramp Terminal Intersections (SDDOT's System)
            1. Intersections where geometry is modified because of project improvements
                a. Minimum allowable LOS – LOS 'C'
                    i. Individual movements will be allowed to operate at LOS 'D' but the overall intersection LOS shall be 'C' or better
            2. Other intersections (intersections within the study area that are not modified by project improvements)
                a. Minimum allowable LOS – LOS 'D'
                    i. Individual movements will be allowed to operate at LOS 'E' but the overall intersection LOS shall be 'D' or better
        ii. Signalized Non-Ramp Terminal Intersections (City of Rapid City's System)
            1. Minimum allowable LOS – LOS 'C'
                a. Individual movements will be allowed to operate at LOS 'D' but the overall intersection LOS shall be 'C' or better
        iii. Basic Freeway, Ramp Junctions and Weave Areas
            1. Minimum allowable LOS – LOS 'C'

3. Variables
    a. Peak Hour Factor (PHF)
        i. Existing (year 2012) conditions analysis will use calculated PHFs from existing counts
        ii. Design year (year 2035) conditions analysis will use PHF of 0.90
            1. This will be confirmed upon development of existing PHFs to determine that 0.90 is reasonable
    b. Saturation Flow Rate
        i. SDDOT Design Manual (Page 24, Chapter 15) requires of the use of 1800 vph in Rapid City. This value will be used for the signalized intersections and freeway locations within the study area.
    c. Traffic Signal Controllers
        i. Operational analysis will allow for both actuated and coordinated controllers
    d. Left-Turn Phasing
        i. Protected, Permitted / Protected or Split Phasing will be allowed at intersections
    e. Lane Utilization Factors (Heaviest Lane Volume parameter in HCS Streets Module)
        i. Default Heaviest Lane Volume values in HCS Streets Module
        ii. Manual overrides to the default Heaviest Lane Volume values will be used for the following locations where field observations indicate that traffic volumes in each approach lane are different

1. La Crosse Street/I-90 Eastbound Ramp Terminal – Northbound Approach (inside through lane has heavier traffic flows because of high traffic volumes destined for the left-turn lane at the downstream intersection to access I-90 westbound)
2. Haines Avenue/Disk Drive – Southbound Approach (outside through lane has heavier traffic flows because of high traffic volumes destined for the right-turn lane at the downstream intersection to access I-90 westbound)
3. North Street/Eglin Street – Northbound Approach (inside through lane has heavier traffic flows because of high traffic volumes destined for the left-turn lane at the downstream intersection to access I-90 westbound)

iii. Year 2035 intersection volumes will be reviewed to determine which approaches would have high lane utilization

f. Heavy Vehicle Percentage
   i. Study Intersections
      1. Use turning movement counts (including truck counts) collected at study intersections during the summer of year 2012 to determine arterial truck percentages.
   ii. Ramp Junctions and Weave Areas
      1. Use freeway counts (including truck counts) collected on I-90 within the study area during the summer of year 2012 to determine freeway truck percentages.

g. Phase Change Intervals
   i. Existing (Year 2012) Conditions
      1. Existing signal timings will be used for phase change intervals during existing conditions
   ii. Design Year (Year 2035) Conditions
      1. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions
      2. Phase change intervals will be calculated for the following locations:
         a. New phases added at an intersection where geometry is unchanged from existing conditions
         b. All phases at an intersection where geometry is changed from existing conditions

      The calculated values will be based on methodologies presented in the *Institution of Transportation Engineers (ITE) Traffic Engineering Handbook.* The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.

h. Speeds
   i. Arterials
      1. HCS Streets Analysis
         a. For the "posted speed" input use the posted speed
         b. For the "Speed Limit to Base free-flow speed (FFS) Ratio" use the spot speed data obtained on La Crosse Street
   ii. Freeway – Use posted speed for FFS/average speed

8. Travel Forecast

Travel Demand Model

1. The Rapid City MPO Travel Demand Model will be utilized for the purposes of this study
    a. The Travel Demand Model was created using TransCAD in year 2002
    b. The Model was updated in year 2008 by LSA and was calibrated through a joint effort between LSA and the City of Rapid City
    c. The Model build year is 2035 to match the current LRTP developed in year 2010
        i. The Travel Demand Model forecasts include:
            1. Constrained projects in the LRTP
            2. Post-processed ADT volumes
    d. Volumes in the Travel Demand Model reflect non-peak season conditions
2. Study Forecasting Methodology
    a. Existing (Year 2012) Conditions
        i. Existing counts will be utilized for existing conditions
            1. Intersection turning movement counts collected during November/December of year 2011 (off-peak season) and turning movement counts that will be collected during the summer of year 2012 (peak season) will be utilized to develop intersection turning movement volumes for the AM and PM peak hours. The year 2012 turning movement counts will be collected for the La Crosse Street study intersections, the Haines Avenue intersections at the I-90 single point ramp terminal and Lindbergh Street and the North Street/Mall Drive intersection. The year 2011 and year 2012 counts will be compared and the higher counts will be used. If the counts from the summer of year 2012 are found to be higher, these counts will be used to adjust the year 2011 counts at the Haines Avenue and North Street study intersections to year 2012 (peak season) volumes.
            2. Freeway counts that will be collected during the summer of year 2012 on I-90 at one location within the study area and the existing volumes on study freeway ramps (based on the intersection turning movement counts at the ramp terminal intersections) will be used to determine AM and PM peak hour volumes for all freeway segments within the study area.
        ii. Volumes will be smoothed/balanced between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps. A figure will be provided that shows the balanced volumes within the entire study area.
    b. Design Year (Year 2035) Conditions
        i. Develop year 2012 ADTs using base year (year 2008) and year 2035 ADTs from the Travel Demand Model. Year 2012 ADTs will be compared to existing (year 2012) peak hour volumes to determine peak hour percentages of daily traffic.
            1. Use a straight-line growth rate between year 2008 ADTs and year 2035 ADTs from the Travel Demand Model to determine year 2012 ADTs for arterial and freeway segments within the study area

ii. Use existing conditions AM and PM peak hour volumes, calculated existing (year 2012) ADTs and year 2035 post-processed ADTs from the Travel Demand Model to generate year 2035 AM and PM peak hour volumes
    1. Develop existing conditions "K" and "D" factors for the AM and PM peak hours on arterial and freeway segments. These will be used to determine the percentage of daily traffic during the AM and PM peak hours and the percentage of traffic on a given segment traveling in each direction
    2. Apply existing conditions AM and PM peak hour "K" and "D" factors and existing AM and PM peak hour turning percentages at intersections to year 2035 forecasted ADTs to generate year 2035 AM and PM peak hour volumes

iii. Volumes will be smoothed/balanced between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps. A figure will be provided that shows the balanced volumes within the entire study area.

9. Safety Issues

Crash data will be reviewed for La Crosse Street within the study area for years 2008 thru 2011. This data was provided by SDDOT from their database. To be consistent through the corridor study, the SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The Rapid City Arterial Street Safety Study from March of year 2012 was also reviewed for any crash information along La Crosse Street within the study area that could provide supplemental information; however, it did not include any information for La Crosse Street locations within the study area. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates
- Crash Trends
- Potential Mitigation Measures to Improve Locations Above Critical Crash Rates

10. Selection of Measures of Effectiveness (MOE)

The main goal of this study is as follows:

- *Develop feasible solutions to address issues and needs that meet current design standards and/or traffic level of service expectations under both the current and predicated future traffic conditions while promoting a livable community that will enhance the economic and social well-being of Rapid City area residents and visitors.*

To satisfy the study objective, the following MOEs will be used to evaluate and compare the concepts:

- Signalized Intersections: **LEVEL OF SERVICE (LOS)** and **INDIVIDUAL MOVEMENT DELAY**
- La Crosse Street Corridor: **LOS, INDIVIDUAL MOVEMENT DELAY** and **SPEED**

- Freeway Segments, Ramp Junctions and Weave Areas: **LOS** and **DELAY**
- Ramp Terminal Intersections: **LOS** and **INDIVIDUAL MOVEMENT DELAY**

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Rapid City guidelines. It is understood that all traffic analysis reporting will be completed using HCM 2010 Methodology.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will be developed for the I-90/La Crosse Street interchange as part of this project. The level of detail for addressing each of the eight (8) FHWA policy points regarding modifications to Interstate access is outlined below.

Policy Point 1 – Need

The IMJR will illustrate that the existing interchange cannot adequately satisfy the future needs at the location without modification of the existing interchange.

Policy Point 2 – Reasonable Alternatives

The IMJR will discuss any alternative improvements that the Study Advisory Team has considered to meet the need of the interchange.

Policy Point 3 – Operations and Safety

The IMJR will evaluate build conditions for the planning year and identify the preferred alternative.

Policy Point 4 – Access Connections and Design

The IMJR will discuss any restricted movements at the proposed modified interchange and list any exceptions to current design standards.

Policy Point 5 – Land Use and Transportation Plans

The IMJR will document any inconsistencies between the proposed modified interchange and future land use or transportation plans in the area.

Policy Point 6 – Future Interchanges

The IMJR will document any effects to and from other interchange improvements within the study area at adjacent interchanges.

Policy Point 7 – Coordination

The IMJR will identify any improvements outside of the interchange footprint in conjunction with the proposed modified interchange. The IMJR will discuss any coordination efforts needed for all improvements associated with the proposed modified interchange.

Policy Point 8 – Environmental Process

The IMJR will provide a status of the planning and NEPA processes, including anticipated schedule dates. Public involvement will also be discussed.

12. Deviations/Justifications

No deviations from standards are currently known. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

13. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this study. If it is determined during the study that deviations are required to any of the sections included in this document, the document will be amended prior to proceeding.

14. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Agenda
- Methods and Assumptions Study Team Meeting Minutes
- Analysis Procedures for Diverging Diamond Interchange (DDI)

APPENDIX

AGENDA
Study Advisory Committee Meeting #1
I-90 Exit 59 (La Crosse Street)
Interchange Options Study

Meeting:	Methods and Assumption Meeting
Date/Time:	June 26, 2012 / 9:00 AM to 11:00 AM (CDT)
Place:	Web Meeting / Conference Call
Conference Call:	(866) 994-6437, Code: 4296852
Attendees:	HDR, Study Advisory Team Members

1. Introductions (Study Advisory Team, HDR)

2. Method and Assumptions

    2.1. Methods and Assumptions Cover Page
    2.2. Stakeholder Acceptance Page
    2.3. Introduction and Project Description
    2.4. Study Area
    2.5. Analysis Years/Periods
    2.6. Data Collection
    2.7. Traffic Operations Analysis
    2.8. Travel Forecast
    2.9. Safety Issues
    2.10. Selection of Measures of Effectiveness (MOE)
    2.11. FHWA Interstate Access Modification Policy Points
    2.12. Deviations/Justifications
    2.13. Conclusions
    2.14. Appendices

3. Other Items

4. Next Steps

5. Adjourn

MEETING MINUTES
Methods & Assumptions Meeting
I-90 Exit 59 (La Crosse Street)
Interchange Options Study

Meeting:	Methods & Assumptions Meeting
Date/Time:	June 26, 2012 / 9:00 AM to 11 AM
Place:	Web Meeting / Conference Call
Attendees:	HDR, Study Advisory Team Members

1. Introductions (City, SDDOT, MPO, FHWA, HDR)

2. Methods & Assumptions Process Discussions
    a. Section 1 – Methods & Assumptions Cover Page
    b. Section 2 – Stakeholder Acceptance Page
        i. The Stakeholder Acceptance Page will include the two optional statements provided in the SDDOT's *Methods & Assumptions Process Template*
            1. "Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-90 Exit 59 (LaCrosse Street) Interchange Options Study*** Final Report or conclusions."
            2. "All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories."
    c. Section 3 – Introduction and Project Description
        i. The schedule will be updated to account for additional time to complete the Methods & Assumptions Document
        ii. The schedule will also be extended to account for the inclusion of an IMJR.
        iii. The Anamosa Street Extension Study will be added to the list of previous studies.
    d. Section 4 – Study Area
        i. The weave areas on I-90 between I-190 and Haines Avenue will be included in the operational analysis.
        ii. The ramp junctions on I-90 east of North Street will be included in the operational analysis.
        iii. The segment of I-90 between Haines Avenue and LaCrosse Street will also consider the addition of an auxiliary lane on I-90. This would result in analysis of this area as a weaving segment.

e. Section 5 – Analysis Years/Periods
    i. Year 2035 will be used as the Design Year and was approved for use by FHWA.
f. Section 6 – Data Collection
    i. Freeway counts will be collected during the AM and PM peak periods at one location on I-90 (both directions) and will include truck counts.
    ii. Counts will be collected for the I-90 westbound to I-190 southbound and I-190 northbound to I-90 eastbound ramps for use in analyzing the weave areas on I-90 between I-190 and Haines Avenue.
    iii. A Saturday count will be conducted on LaCrosse Street at the I-90 eastbound ramp terminal to determine weekday/weekend variation.
    iv. A speed study on LaCrosse Street during off-peak times will be conducted to determine arterial free-flow speed.
g. Section 7 – Traffic Operations Analysis
    i. For the ramp terminal intersections (on SDDOT's system) level of service (LOS) 'D' will be the minimum allowable LOS for an intersection before requiring additional improvements.
    ii. The PHF for the Design Year conditions will be 0.90 (dependent on the existing PHFs).
    iii. Lane utilization factors will be based on the default values provided in Synchro with the exception of locations where field observations indicate heavy lane utilization. These locations will be listed in the M & A document.
    iv. Minimum phase change interval timings will be based on the existing signal timings and calculated phase change interval times. The calculated times will be based on the geometry of the intersection and the methodologies presented in the *ITE Traffic Engineering Handbook*.
    v. Information from the speed study to be collected on LaCrosse Street will be used for arterial free-flow speed. The average arterial travel speed will be 3 mph below the posted speed. The free-flow speed on the freeway will be the posted speed.
    vi. Inclusion of simulation on the project still needs to be determined.
h. Section 8 – Travel Forecast
    i. Diagrams will be provided that show balanced volumes
i. Section 9 – Safety Issues
j. Section 10 – Selection of Measures of Effectiveness
k. Section 11 – FHWA Interstate Access Modification Policy Points
    i. An IMJR will be needed for this project. The level of detail for addressing the Eight Policy Points will be determined at a later date.

l. Section 12 – Deviations/Justifications
m. Section 13 – Conclusions
n. Section 14 – Appendices

3. Other Items

4. Adjourn

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To:	I-90 Exit 59 (La Crosse Street) Interchange Options Study Advisory Committee		
From:	Mike Forsberg Brian Ray	Project:	I-90 Exit 59 (La Crosse Street) Interchange Options Study Project PL 0100(89) 3616 P, PCN 03KM
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Date:	June 19, 2013	Job No:	183454

RE: Analysis Procedures for Diverging Diamond Interchange (DDI)

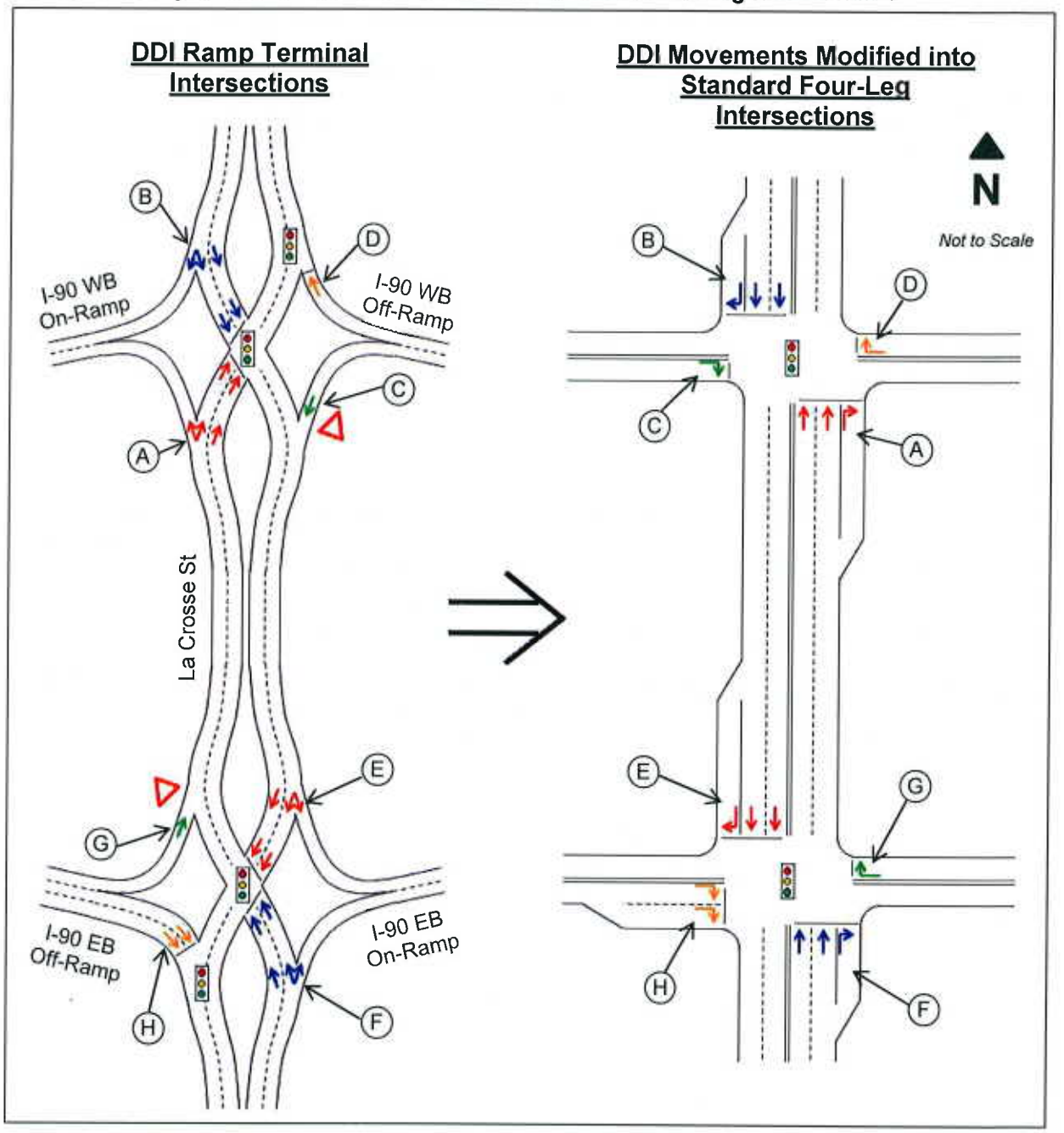
Introduction

This document presents a proposed methodology for analyzing a Diverging Diamond Interchange (DDI) for the I-90 Exit 59 (La Crosse Street) Interchange Options Study. The approved Methods & Assumptions document for the project specifies that analysis of interchanges will be conducted with the Highway Capacity Software (HCS) 2010 Streets module. The Federal Highway Agency (FHWA) has indicated that HCS 2010 is the preferred traffic analysis tool for this project. Four initial concepts for the I-90 Exit 59 interchange were presented to the Study Advisory Committee (SAT) on March 28th, 2013 and a DDI was included as one of the concepts. The procedures documented in this memorandum were developed in response to known challenges of analyzing DDIs in HCS 2010 based on discussions with the software developer, McTrans.

Proposed DDI Analysis Methodology

The proposed analysis methodology for DDIs includes manipulation of the intersection movements at a DDI to analyze the ramp terminal intersections as standard four-leg intersections in HCS 2010. The proposed methodology involves manipulating the movements at the DDI ramp terminal intersections of the proposed DDI concept to conform to the analysis methodology of HCS 2010 while mimicking similar operational elements of the DDI ramp terminal intersection. **Figure 1** expresses the proposed manipulation of the DDI ramp terminal movements into a format with standard four-leg intersections. The modified standard four-leg configuration shown in **Figure 1** would have split-phase operations for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange.

Figure 1. Manipulation of DDI Movements into Standard Four-Leg Intersections



The following presents details of the proposed manipulation of intersection movements for the westbound ramp terminal intersection shown in **Figure 1** from the DDI configuration to a standard four-leg intersection configuration. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- The DDI westbound ramp terminal intersection would operate as a two-phase signal. The northbound crossover movement (A) and westbound off-ramp left-turn movement (C) would travel through the intersection during the first phase (phase 2). The southbound crossover

movement (B) and westbound off-ramp right-turn movement (D) would travel through the intersection during the second phase (phase 6).

- The two-phase operations of the DDI would be modified to two-phase operations with a four-leg intersection configuration. For example, at the westbound ramp terminal intersection:
    - The northbound crossover movement (A) of the DDI would be treated as a northbound through movement in the four-leg intersection configuration.
    - The northbound left-turn movement of the DDI in advance of the crossover would be treated as a northbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the northbound right turns would be set to zero. This assumes that all northbound right turns would only be able to turn during the northbound green signal indication. This assumption is conservative since these vehicles would be able to make this turning maneuver during a northbound red signal indication in the DDI configuration, while the northbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the northbound through movement would extend beyond the turning movement location, it was assumed that no vehicles would be able to turn right on red.
    - The southbound crossover movement (B) of the DDI would be treated as a southbound through movement in the four-leg intersection configuration.
    - The southbound right-turn movement of the DDI in advance of the crossover would be treated as a southbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the southbound right turns would be set to zero. This assumes that all southbound right turns would only be able to turn during the southbound green signal indication. This assumption is conservative since these vehicles would be able to make this turning maneuver during a southbound red signal indication in the DDI configuration, while the southbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the southbound through movement would extend beyond the turning movement location, it was assumed that no vehicles would be able to turn right on red.
    - The westbound off-ramp left-turn movement (C) of the DDI would be treated as an eastbound right-turn movement in the four-leg intersection configuration.
        - This movement would be treated as an eastbound right-turn movement at a signal with RTOR allowed. The value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro traffic analysis software (Synchro would be used to code the modified four-leg configuration and obtain the RTOR value for this movement).
    - The westbound off-ramp right-turn movement (D) of the DDI would be treated as a westbound right-turn movement in the four-leg intersection configuration.

        - RTOR for the westbound right-turn movement would be restricted in the DDI configuration; therefore, the RTOR of the westbound right-turn movement four-leg configuration would be set to '0'.
    - In the modified version of the four-leg intersection the northbound (A) and eastbound (C) movements would travel through the intersection during the same phase (phase 2). This would be consistent with the overlapping northbound crossover movement (A) and westbound off-ramp left-turn movement (C) of the DDI.
    - In the modified version of the four-leg intersection the southbound (B) and westbound (D) movements would travel through the intersection during the same phase (phase 6). This would be consistent with the overlapping southbound crossover movement (B) and westbound off-ramp right-turn movement (D) of the DDI.

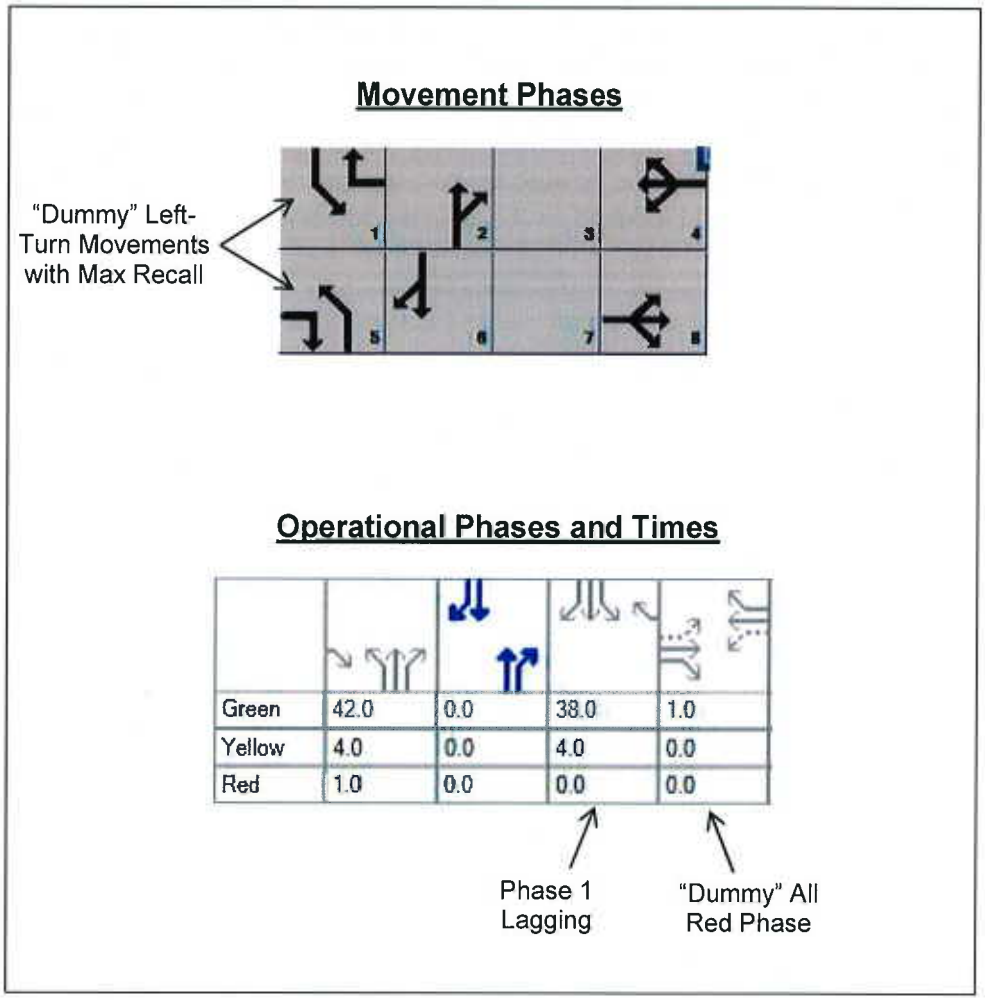
The following presents specific details of coding elements in HCS 2010 Streets to model the westbound ramp terminal intersection shown in **Figure 1** as a standard four-leg intersection of the DDI intersection. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- To model split-phase operations for the major street (northbound and southbound movements) in HCS 2010 Streets the following coding elements would be needed. Additionally, the diagrams shown in **Figure 2** supplement the coding elements listed below.
    - Artificial ("dummy") northbound and southbound left-turn movements would be added with protected phasing. These movements would not serve any of the DDI traffic. The added left-turn phases would be phase 5 for the northbound left-turn movement and phase 1 for the southbound left-turn movement.
    - The eastbound and westbound right-turn movements would be overlapped with the northbound and southbound left-turn movements.
    - The southbound left-turn movement would be set to a lagging left-turn phase so that the northbound and southbound left-turn movements would not need to have a green signal indication simultaneously.
    - The Recall Mode for the northbound and southbound left-turn movements would be set to 'Max'.
    - The Phase Split times for the northbound and southbound left-turn movements (phases 5 and 1, respectively) would be set to the optimum phase split times for the northbound and southbound movements. The combined split times for the northbound and southbound left-turn movements would equal the cycle length of the signal, leaving no remaining time for the overlapping phase where northbound and southbound through traffic would travel through the intersection simultaneously.
    - Eastbound and westbound phases (phases 8 and 4, respectively) would be required to be included to meet the criteria for signal timings in HCS 2010 Streets. These phases would have a green signal indication simultaneously for 1 second and effectively serve as the Red time for the previous split that serves southbound traffic (labeled as "Dummy" All Red Phase in **Figure 2**). To counter the additional 1 second of green time given to the eastbound and westbound right-turn movements, each of these movements would be given an additional 0.5 seconds of "Start-Up Lost Time". Each of these right-turn movements would experience the extra 0.5 seconds of "Start-Up Lost Time" during the "Dummy" All Red Phase and during their normal

phase of operation (Phase 1 or 5), totaling 1 second of additional "Start-Up Lost Time" over the course of 1 signal cycle for the eastbound and westbound right-turn movements.

- The Demand for the northbound and southbound left-turn movements would be set to '1' in order for phases 1 and 5 to be given a green signal indication (otherwise, all of the time would be given to the phase where northbound and southbound traffic move through the intersection simultaneously).

Figure 2. Sample HCS 2010 Streets Phasing for the Westbound Ramp Terminal Intersection



- The following coding elements would also be included in HCS 2010 Streets to mimic the movements of the DDI.
  - The Arrival Type for the eastbound and westbound right-turn movements would be '3', representing random arrivals from the freeway. The Arrival Type for the northbound and southbound approaches would be '4', representing coordination of signals. However, the arrival patterns of the northbound and southbound movements would be dictated by the signal timings at upstream intersections and the

coded Arrival Type for the northbound and southbound approaches would not have any impact on the operations at these intersections.

- The signal would operate with a 90-second cycle length to match the signal timings at the adjacent La Crosse Street signals at Disk Drive and Eglin Street.
- Phases 1 and 5 would operate with 4 seconds of yellow and 1 second of all red.
- The speed limit would be set to 25 mph to account for lower speeds through the crossover and channelized turn movements. The exception to this would be for the southbound approach that arrives from outside of the DDI and would be set to the speed limit of La Crosse Street, 35 mph.

As mentioned previously, the modified standard four-leg configuration would have split-phase operations at the ramp terminal intersections for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange. The signal offsets values at the ramp terminals would be based on the turn patterns at each intersection to maximize platooning of traffic through the two signals. Signal offsets at intersections adjacent to the ramp terminals would be based on the offsets established at the ramp terminal intersections.